

M. M. LEIGHTON
THE STORY OF
THE PENNSYLVANIA SURVEY

By George H. Ashley



(The Heart of Philadelphia, Courtesy of Joseph Pennel.)

"This land was inhabited long before the Coming of William Penn, but he found here neither a great civilization nor wealth."

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THE PENNSYLVANIA SURVEY

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BY GEORGE H. ASHLEY



An example of the Pennsylvania spirit of venture and achievement that is one reason for her greatness. (Snake Hollow, near McKeesport, Pa.)

There are two other reasons: First, the possession of great natural resources; Second, knowledge of those resources through official and unofficial surveys, wherein "The Pennsylvania Survey" plays a part.

DEPARTMENT OF INTERNAL AFFAIRS

James F. Woodward, Secretary

BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY

George H. Ashley, State Geologist

HARRISBURG

1922

Copyright, 1922

By JAMES F. WOODWARD

Secretary, Dept. of Internal Affairs
for the

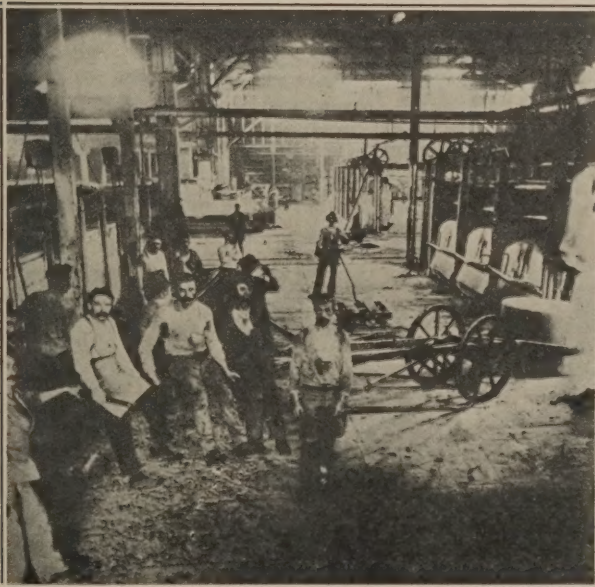
Commonwealth of Pennsylvania

THE STORY OF THE PENNSYLVANIA SURVEY*

By GEORGE H. ASHLEY

WHY IT EXISTS

Pennsylvania has well been called the industrial Titan of the western world. Its industry, like that of every other state or nation, is based on its



natural resources, and its wealth and progress are measured by their development and use. Man may be ever so resourceful, ingenious and ambitious, but without raw materials out of which to build, construct or grow those things needful for the upbuilding of a material civilization, he can never advance beyond the stage of savagery.

These raw materials, one and all, come out of the earth, whether as foods or timber growing out of the soils that mantle the earth's surface, the clays out of which he makes bricks for a dwelling place, or coal and iron, oil and gas,

*This article includes the annual report of George H. Ashley, State Geologist, made to James F. Woodward, Secretary of Internal Affairs, of the work of the new Bureau of Topographic and Geologic Survey of Pennsylvania, and in addition tells why the Survey exists, mentions McKeesport gas and some other interesting matters and tells somewhat of the Survey's plans for the future.

lead and zinc, for which he must dig far below the surface. The earth not only serves him as a place on which to live but supplies all of his physical needs, and with such materials as he finds in his own land he may trade with the ends of the earth for the treasures of their lands.

Is it any wonder then that from the earliest times, a knowledge of the earth and its resources has gone hand in hand with the material advancement of man. Unfortunately, nature has not been equally kind to all lands in her gifts. Upon some she has lavished rich soils, precious and base metals, coal, clay and building stone, flowing rivers and a salubrious climate. On others she seems to have turned her back, leaving only deserts or inhospitable mountains or ice bound coasts.

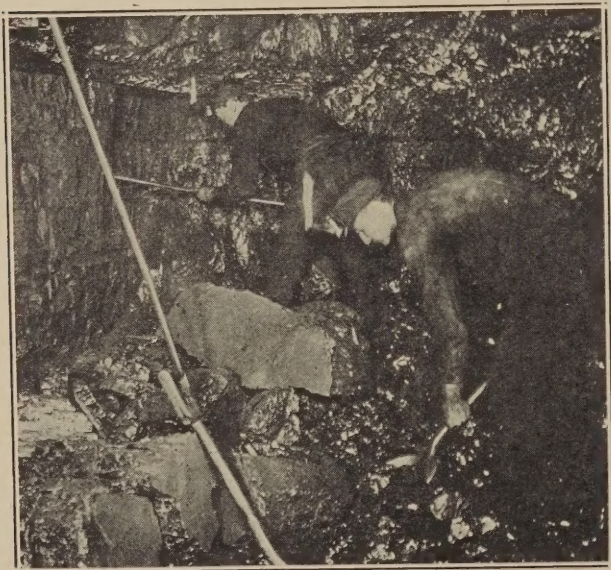
Look back through history, and beneath every great nation of all times is an earth rich in fertile soils and mineral resources transformed into instruments of power and wealth by the ingenuity and industry of man. Look again and notice how literally the wars and migrations of the past have been the struggle and search for better soils and for raw materials. There are even those who find the cause of the late war in Germany's supposed need for the control of more of the raw materials required by her industries if her progress was not to be throttled.

With these thoughts in mind it is not difficult to see why Pennsylvania should have been destined to become a great Commonwealth with her fertile soils and vast forests, her great deposits of high grade coal, her iron, clays, oil and gas, her limestones and sandstones, marbles and granites, and dozens of other mineral resources.

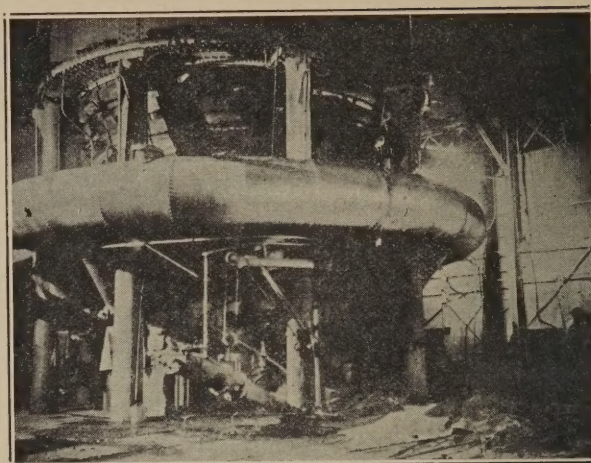
But there is another side to the story. The possession of great mineral resources alone does not make a state or nation prosperous or wealthy. This land was inhabited long before the coming

of William Penn, but he found here neither a great civilization nor wealth. There must be the eye to see and the knowledge to recognize the value of what it sees and the possibility of development of the things seen for use at home or in trade. There must be the energy and ingenuity, the patience and will to till and sow the soils, to transform the forests into houses and furnishings, to dig the coal and iron and mould them into rails and engines, to burn the brick and carve the stone. Here is the second secret of Pennsylvania's greatness.

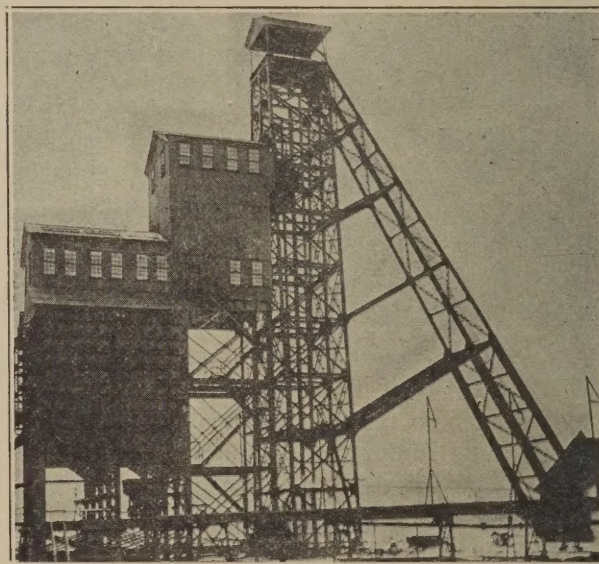
It is not that her soils are so much richer than those of other states. On the average they probably do not compare with those of Illinois. Her forests are not better than those of many states to the southwest of her. Her coal beds were originally not first but eighth among the states in tonnage of coal. North Dakota has nearly four times as much tonnage, Wyoming three times, Colorado nearly three times, Montana more than twice, Illinois nearly twice, and New Mexico and West Virginia a little more.



as many tons of coal each year as all of the other and yet for years Pennsylvania produced twice states combined, and to-day produces nearly one-half of all the coal produced in the United States. Pittsburgh was shipping coal away by boat eighty years before the Pocohontas coal of Virginia and West Virginia was discovered. Pennsylvania digs out of the ground each year only about one-half million tons of iron ore, worth less



than one million dollars; yet in 1918 her furnaces turned out nearly one-half billion dollars worth of pig iron and so on down the list. With no production of the precious metals, and almost none of any metals except iron, Pennsylvania,



(like the lofty tippel here shown) stands in a class by herself in mineral production, not only head and shoulders above her competitors, but actually dwarfing them, as, by comparison, her nearest competitors stand only about knee high.

Why has this been so? There is but one explanation. Knowledge backed by the will and energy to do. As early as 1768 the Penn proprietaries had purchased from the Chiefs of the Six Nations, the whole of the bituminous coal fields of Pennsylvania, except that part which lies

northward of Kittanning, which was not purchased until 1784. In 1794 coal was being used to run a steam engine in Pittsburgh and to evaporate salt; and in 1797 coal was being used to manufacture glass. A dozen years later from 40 to 50 coal mines had been opened in the Pittsburgh district, and coal was in general use in houses in that section, and it was not long until Pennsylvania was digging canals, and portaging her canal boats over the mountains to bring her mineral resources to market, while her neighbors hunted beaver and sold skins.

It is because of this spirit that Pennsylvania leads all of the states in the production of cement, coal, ferro-alloys, pig iron, limestone and lime, zinc and lead pigments, sand and gravel, slate, stone, sulphuric acid from copper and zinc smelters, and is second in production of clay products, raw clay, diatomaceous earth, tripoli and silica. Pennsylvania is third in the production of natural gas but first in its utilization, gathering the raw product from her neighbors and using it to multiply her own wealth and comfort. **Petroleum is wide spread over the United States, but Pennsylvania led the way in its discovery and produc-**



tion through the drilling of the Drake well, here shown, in 1859.

It was doubtless this same spirit that at the beginning of the last century led to the formation at Philadelphia, of the American Philosophical Society, the Academy of Natural Sciences and the Franklin Institute, and in 1832 to the Geo-

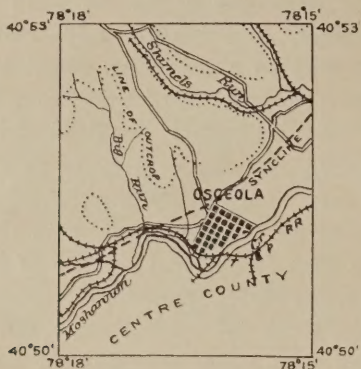
logical Society of Pennsylvania. The organization last named marked the beginning of a new era in American science. It brought to a focus the activities of a number of local societies scattered over the state. It held meetings in Philadelphia, Harrisburg and Pittsburgh. Its purpose was to obtain "An exact knowledge of the mineral resources of this State * * * to construct * * * an accurate geological map."

It is not necessary to retrace the steps by which this ambitious undertaking was finally taken over by the State, when in 1836, it organized the first Geological Survey of Pennsylvania under Henry D. Rogers. This Survey, which continued its work for several years, led to the publication of two large volumes on the geology of the State. It was this same spirit that led the State in 1874, the year following the great panic, to organize the Second Geological Survey of Pennsylvania under Lesley, and to support that Survey liberally for many years. Reports of that Survey today contain a vast fund of information which has been of inestimable value to the mineral development of this State. These reports are still sought as a guide for the promotion of its new mineral industries. They have long been out of print and today are available only in the public libraries.

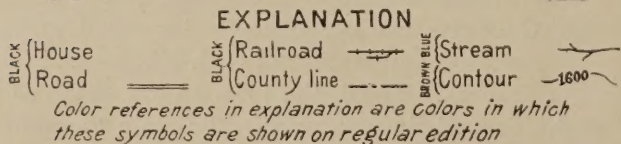
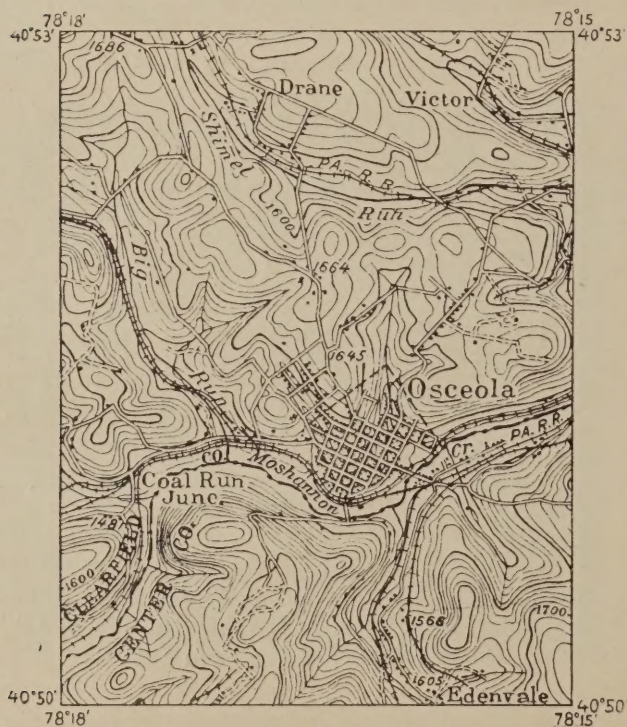
It was this same spirit that in 1898 and again in 1919 led the state to initiate a more detailed survey of the State's resources, in a belief that a better knowledge of those resources would still further advance the State's progress and maintain its industrial preeminence.

The Second Pennsylvania Survey covered the State more or less completely and published some 88 volumes, with many volumes of maps. It may therefore be asked "Why should the new Survey be undertaken?" There are three reasons for this; First, the old reports have been out of print and unobtainable for many years. Second, since that Survey was made our knowledge of the geology of the State has been greatly increased through exploration and mining of coal, oil, gas and other substances. Third, the information obtained by the Second Survey, was in the main too general and too lacking in detail, and based on base maps too poor to meet the needs of today. This phase of the problem is best illustrated by comparing two copies of the maps; one, of a portion of a

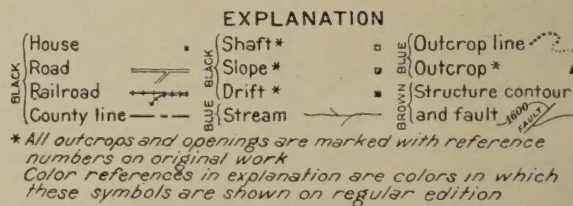
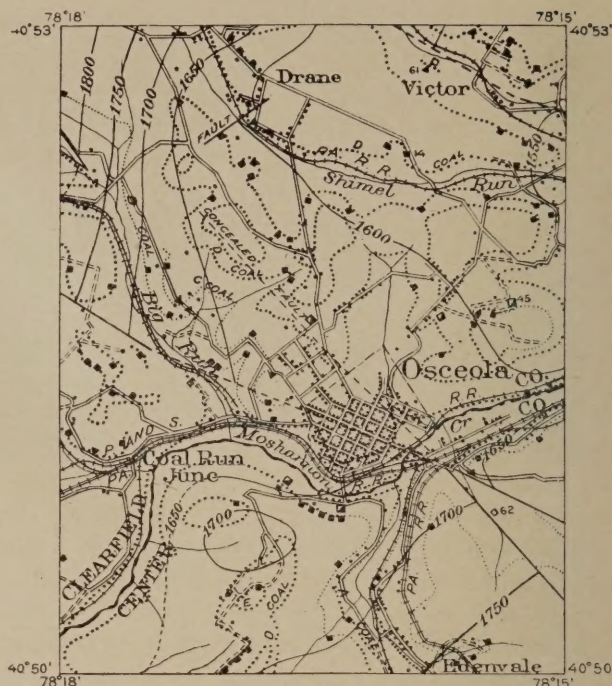
typical map of the Second Survey, and another of the same area, as mapped today. It must be remembered that both maps as published are in color, and therefore much more legible than as here shown.



For example, above is a fragment of the map of Clearfield County, as published by the Second Pennsylvania Survey, Vol. H7.



Above is a copy to scale, of the new topographic map of exactly the same area, showing not only railroads, roads and houses but the exact shape and elevation of the hills and valleys. (The original is in three colors.)



Above is a copy, to scale, of the new geologic map of the same area (without colors) showing the outcrops of the several coal beds, the location of all coal openings, and the elevation of the Moshannon coal bed above sea level by contour lines. (In the original, each opening is numbered for reference to text descriptions, coal sections and analyses.)

To those who wonder why the state should be called upon to make such surveys as these, rather than that they be left to private initiative, it might be pointed out:

1st—To save the endless repetition of field examinations when made by private parties. Suppose in a year 100 men in Pennsylvania want to know for commercial purposes, where a certain kind of rock may be found. How should they go about finding such a rock? (assuming there were and had been no state survey). There is only one way—to go themselves or to hire someone else to tramp over the state, after the manner of the old gold prospectors, hunting for the rock desired.

Instead, they should be able to send to the State Geologist and receive by return mail, a report on the stone of the state, showing just where the desired stone may be found, where there are quarry sites, how much stone can be gotten out in any of these, the amount of stripping necessary, the character of the stone at each site as regards color, hardness, grain, chemical analysis, etc.

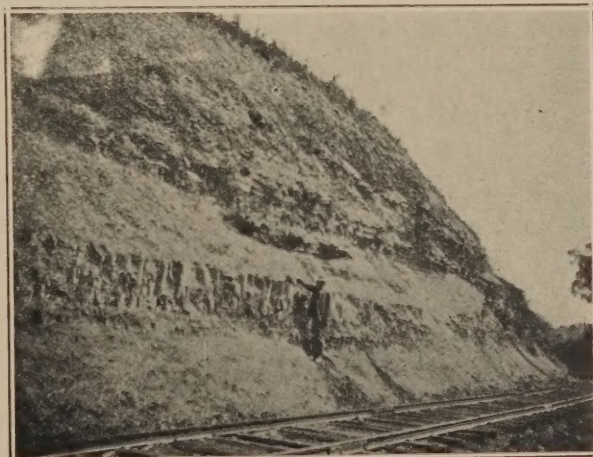
2nd—It is not enough as a rule to simply find a rock or clay or coal or other deposit. The rock must be tested to know its strength or resistance to weathering: the clay must be burned to know the kind of brick it will yield: the coal must be analyzed to know how much ash and sulphur it contains and how much heat it will yield. Without official surveys, every man must not only seek what he desires in the field, but must take samples at perhaps hundreds of outcrops, and build laboratories or send to commercial laboratories to test those samples. If only one man or one corporation were interested in these matters, the testing should be left to that man or corporation: but there are many men and many corporations, indeed, any citizen of the State, especially one who owns land in the State, may desire just such information. Therefore, the State believes it is economy to employ a single corps of men to do this work just once for all of the people, gathering while on the ground, information about all of the resources of all the areas covered.



3rd—While coal and many of the rocks show on their face just what they are, most of the ores have little or no resemblance to the metals they

contain, and their finding requires men trained in the recognition and testing of ores and minerals. Therefore the State Survey offers to all of the citizens of the state, the advantage of an official, reliable, unbiased corps of men trained in this knowledge, such as only a great corporation could afford to employ for its own information and advantage.

4th—And most important of all. Most of the mineral resources of Pennsylvania lie in beds which are in general found far below the surface. The geologist, by a study of the rocks over a broad territory, can construct sections showing the relative position and thickness of all of the rocks, so that any rock at the surface is a key to the position of all of the rocks under the surface. He can thus tell to within a few feet the depth of the Pittsburgh coal in western Greene County, where it is 1,000 feet deep and 25 miles from the nearest surface exposure. He can tell the approximate depth of the "Clinton" sandstone under Pittsburgh, though exposed only in central Pennsylvania and thinning out in central Ohio, while still 2,500 feet deep. To get this information regarding the rocks under one spot, it may be necessary to survey thousands of square miles of territory, but when gotten this information may serve as well for a thousand other spots. The same condition faces us if we seek to know the lay or structure of the rock; that is, the position of the anticlines and synclines with reference to the occurrence of oil and gas, or to the laying out of coal mines so as to secure the cheapest drainage and haulage.



If citizens of the State are to know what underlies their land at the least possible cost, they must

unite in employing a geological corps to make the necessary surveys and reports, or what is the same thing, establish a State Geological Survey. It is because of the recognition of this fact that the State Survey exists.

The service of the Survey to the State Government, to the mineral industries and to the public at large, may be summed up as follows:

1—State and local governments:

a—By topographic mapping; showing: (1) Necessary location and grades of roads and streets and other transportation systems; (2) Location and grades of sewerage or water supply systems; reservoirs, etc.; (3) Data for town planning and district improvement; (4) Data needed for conservation and controlling of water supplies and power, location of dams, etc.; (5) Surface features as affecting location of forest reserves, sanatoriums, grounds for military purposes, etc., etc.

b—By advising on location and character of (1) Road materials near roads to be built; (2) Structural materials, for bridges, etc.; (3) Fuel supplies; (4) Mineral resources tributary to proposed transportation routes; (5) Mineral supplies needed by any government department.

c—By supplying data needed in the consideration of possible legislation affecting mineral reserves, or the mineral industry, or the assessment of taxes.

2—The mineral industries, engineers and students of geology:

a—By surface mapping of rocks or minerals of known or possible economic value.

b—By determining at any point the probability of the presence of and the depth or position of non-out-cropping deposits.

c—By determining the limits within which certain minerals or rocks may be found.

d—By determining the lay or structure of certain bedded deposits when such structure bears on their exploitation. e. g., coal and oil.

e—By the study, description and comparison of the character and quality of economic rocks and minerals as affecting their use and value.

f—By the location and estimation of reserves of ores or minerals.

g—By calling attention to opportunities of mineral development.

h—By the search for and possible discovery of new minerals or of new deposits of needed minerals or rocks as near as possible to points of use.

i—By the topographic mapping which may aid in the location and planning of railroads, telegraph and power lines, sites for mining or manufacturing towns, water supply and sewage disposal, etc., etc.

3—The general public:

a—By the identification of rocks and minerals.

b—By answering inquiries regarding the earth's surface, history, composition and structure, use, content at any point, etc.

c—By advising regarding mineral values of lands, prospective exploitation, etc.

d—By areal reports covering various factors affecting use of land or living conditions.

e—By supplying elevations, distances, directions, grades and other geographic information.

f—By preventing unpromising exploitation, or investment.

g—By stimulating and guiding the search for desired minerals and their discovery.



Does the traveler wonder as he sees from the train the great beds of rock bent and twisted in huge folds as though by some Titanic hand,—the Survey will tell him the story.

- h—By stimulating an interest and a knowledge of the earth and its history in relation to man, his history and economic progress.
- i—By showing automobilists and other travelers the character of country, grades and other matters of interest along their proposed line of travel.
- j—By supplying public school children, and other citizens, with information about their State, its resources and surface features, their origin and value.

It was because of a recognition of these facts that the State Legislature established and supported the First and Second Geological Surveys of Pennsylvania as described, and again in 1898 established a Topographic and Geologic Commission which secured the cooperation of the U. S. Geological Survey and made a good beginning of both a topographic and a geologic map of the State. As the Commission had no office at the State Capitol for giving information it did not receive the support needed and was abolished in 1919 and a new Topographic and Geological Survey was established as a Bureau of the Department of Internal Affairs under James F. Woodward, Secretary of that Department. The bill was signed by the Governor June 7, 1919, and a State

Geologist, Geo. H. Ashley, formerly Chief of the Section of Eastern Coal Fields, Chief of Coal Section, Land Classification Board, and sometime Acting Director of the Federal Geological Survey, was appointed. Mr. Ashley had had charge of the cooperative work of the Federal Survey in Pennsylvania for many years and therefore had a wide personal knowledge of the State. In addition to his experience with the Federal Survey he had formerly been State Geologist of Tennessee, Assistant State Geologist of Indiana, Assistant on the Geological Survey of Arkansas, and had had a wide personal experience from New England to California.

THE FIRST YEAR'S WORK.

The work of the new survey began September 1, 1919, the Survey occupying part of the rooms in the Capitol previously occupied by the State Bureau of Mines.

As, due to the congested condition of the State Printing, the new Bureau has issued no printed publications during the year, it has seemed wise to present in this manner a brief review of the work of the Bureau for the year to Sept. 1, 1920, and a glimpse of its plans for the future.

The work of the Survey naturally falls into four lines—Administration, Information, Survey and Publication.

Administration.

The administrative work of the first year has naturally been heavy. It has included:

1. **The physical outfitting of the plant.** This included the planning and procuring from the ground up of desks, tables, files, book and map cases, cabinets, and other furniture and supplies; and an adequate field outfit from hammers to plane tables. The work has been greatly handicapped by the slow delivery or non-delivery of this equipment. Including the State Geologist's personal books, a library of probably 3,000 volumes and pamphlets has been built up, and a working collection of maps is constantly being added to. A beginning has been made toward the collection of photographs of characteristic Pennsylvania scenery and geology and of typical specimens of Pennsylvania rocks and minerals.

2. **The making of plans.** This involved, first, a comprehensive and detailed review of the present status of topographic mapping in Pennsylvania and of published information about Pennsylvania geology. Second, the determination of just what work remained to be done. Third, the preparation of detailed plans for the accomplishment of that work in full. Fourth, accurate estimates of the total cost of the work, based on present and past known costs, and the preparation of alternate budgets covering the complete work of the Survey for selected periods of years. Fifth, the determination of the form and character of publications, involving a review of all present usages with their advantages and disadvantages and the preparation of a complete list of proposed principal publications. The present paper has the size and character of page determined on. The three principal advantages of this size are: 1st, the quadrangle topographic sheets which will be used in the Atlas and some other reports fold twice to this size; 2nd, this size allows the publication unfolded of plates and charts of double octavo size, and reduces the number of foldings required of large maps; 3rd, brochures of this size will fold once vertically for insertion in pocket (like a railroad time table) for use in the field, or while traveling. Sixth, the working out of certain standards to be used by the Survey, such as a standard geological time scale. (No generally accepted time scale exists at present, each Survey or author having its or his own.) Proposed standards have been the subject of extensive correspondence and office conferences. Seventh, the working out of a large variety of record forms, ranging from weekly report cards for clerical work to elaborate field records for guiding field studies of economic resources. Eighth, the preparation of Survey "Regulations and Instructions." Certain of these prohibit any member of the Survey acquiring or holding any mineral rights in the State or the stock of any company or corporation owning or mining minerals within the State; nor may any member of the Survey, while so employed, execute any private surveys or examinations within the State. Confidential information must be carefully guarded or used strictly in accordance with stipulated conditions. Ninth, attendance at numerous conferences and meetings at Pittsburgh and else-

where dealing with matters relating directly or indirectly to the work of the Survey.

3. **The selection and direction of the Survey personnel.** Neglecting separations, the force on December 31, 1920, consisted of the State Geologist, two associate geologists, two assistant geologists, thirteen cooperating geologists, twenty-two cooperating topographic engineers and thirty topographic assistants; three clerks and stenographers and two draftsmen.

The Survey Personnel:

GEOLOGY.

- George H. Ashley, State Geologist.
 J. French Robinson, Associate Geologist. Graduate of University of West Virginia. Formerly asst. geologist for the B. & O. R. R. Company; later in charge of three mines (Franklin Coal & Coke Co.), in West Virginia; later the geologist for the Seneca Hill Oil Company operating in the southwestern fields.
 J. Ross Corbin, Associate Geologist, Graduate of Lehigh University. Iron mining, Pennsylvania and New Jersey. Graphite, New Jersey. And in Arizona, California, Colorado, Utah, Virginia, Philippine Islands and China, for gold, silver, platinum, copper, lead, zinc, iron, manganese, chromite, etc. Geological relations of pondage areas in Connecticut.
 J. D. Sisler, Assistant Geologist. Graduate of University of West Virginia. Post Graduate work Johns Hopkins University. Assistant, Geological Survey of West Virginia. Later, Assistant Geologist, Geological Survey of Maryland.
 Meredith E. Johnson, Assistant Geologist. Graduate of Lehigh University. Engineer Corps of Army. Later Head Sampler and Geologist, Ray Consolidated Copper Co., Arizona.

Cooperating Geologists: (13 following):

- Dr. F. Bascom, Bryn Mawr College, Bryn Mawr, Pa.
 Prof. Malcolm H. Bissel, Bryn Mawr College, Bryn Mawr, Pa.
 Prof. C. A. Bonine, State College, State College, Pa.
 Dr. H. L. Fairchild, University of Rochester, Rochester, N. Y.
 Prof. Charles R. Fettke, Carnegie Institute, Pittsburgh, Pa.
 Prof. George N. C. Henschen, Harrisburg High School, Harrisburg.
 Prof. Erle G. Hill, Carnegie Institute, Pittsburgh, Pa.
 Dr. A. I. Jonas, U. S. Geological Survey, Washington, D. C.
 Dr. Benjamin L. Miller, Lehigh University, Bethlehem, Pa.

Dr. E. S. Moore, State College, State College, Pa.
Prof. Frederick B. Peck, Lafayette College, Easton, Pa.

Mr. Thomas G. Taylor, State College, State College, Pa.

Dr. Edgar T. Wherry, U. S. Dept. of Agriculture, Washington, D. C.

*Roland W. Brown, Geologic Aid. Graduate of Lafayette College. Formerly with the Bureau of Chemical Welfare, U. S. Army.

**C. W. Webbert, Assistant to State Geologist. Formerly with the State Department of Health.

O. P. Solem, Chief Draftsman. Formerly with the U. S. Emergency Fleet Corporation of Philadelphia.

John G. Hanford, Draftsman. Formerly with the Bureau of Good Roads, Washington, D. C.

Mrs. Lizette F. Carey, Chief Clerk, Harrisburg, Pa.

Miss Jean N. Rauch, Stenographer and Librarian.

Miss Elizabeth B. Garner, Typist and Mimeograph Operator.

TOPOGRAPHY.

Frank Sutton, Geographer in charge.

Topographic Engineers:

C. C. Gardner	Max J. Gleissner
Robert Muldrow	S. L. Parker
Duncan Hannegan	J. L. Lewis
J. Irving Gayetty	Oscar Jones
J. F. McBeth	

Assistant Topographic Engineers:

H. E. Simmons	M. A. Roundabush
J. C. Hilliard	A. J. Kavanagh.

Junior Topographic Engineers:

W. S. Beames	Frank M. Schilling.
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Field Assistants:

Walter McCrea	F. J. McMaugh
C. R. deMedicis	W. F. Chenault.

Computer:

J. L. Lenovitz.

Rodmen:

Matt Daura	G. A. Mock
Neilson Jones	Bert Griffith
J. S. Ward	J. J. Caille
Albert A. Carney	Roy Wiltse
Charles W. Smith	P. H. Clark
M. A. Hufty	Robert Holden
Palmer Kuhns	Frank S. Jamison
H. P. Bresee	Philip Croyle
Charles C. Dunn	T. Wilson
F. H. McBeth	H. C. Loney
E. T. Greenstreet	A. B. Claxton
E. D. Chamberlain	S. G. Rivers
Mark H. Secrist	Boyd Baker
Farnham Warriner	Robert Marvin
P. A. Trapin	Ernest Snyder
Pierce Hills	Wm. A. Dickson
Geo. C. Chenault	Robert McCulloch.

Information.

The second line of Survey work, the giving of information, has taken a large amount of the State Geologist's time and most of the time of the clerical force. Over 1,000 people have called at the office for information in person, 5,600 letters have been answered, 5,858 copies of reports of the preceding Survey still held by the State Division of Documents have been mailed in response to direct requests by letter, and several hundred of these reports have been distributed direct from this office. Eight hundred mimeographed advance reports of this Survey have also been mailed from this office. A Loan Library has been established from which over 100 reports out of print have been loaned. Most of the volumes available for this purpose have been presented to the Survey by friends. Co-operation has been established with all of the principal libraries of the State, by which the Survey aids them to complete their sets of old State geological publications, and in return refers to them the correspondents who ask for reports no longer available for distribution. In addition to the two preliminary reports mimeographed for immediate distribution, a large number of press bulletins have been prepared and distributed through the Department's Bureau of Publicity.

To give some idea of the possible value of the correspondence carried on by the Survey, there is inserted here a brief of a typical single day's answered letters. This is taken from the State Geologist's report to Secretary Woodward for the month of February, and was given there simply to illustrate what was meant by the term "routine correspondence" used in many of his monthly reports. The letters as usual required more than one day for their completion and dispatch.

By Miss Rauch as follows: inquiries in regard to
oil, Oakdale, Allegheny County and Lawrence County.
oil and gas, Pleasant Hill, Lawrence County.
oil, gas and salt deposits, Washington County.
oil formation of Pennsylvania.
geological formations of the Beaver quadrangle.
anticline through Lower Tyrone Township, Fayette County, depth of various sands and what each produces.
Dorseyville Field, West Deer Township, Allegheny County.
oil and coal deposits of State.
map showing Pennsylvania coal fields.

*Mr. Brown resigned September 15, 1920.

**Mr. Webbert resigned May 1, 1920.

oil and gas, Indiana and Westmoreland counties.

geological map of Pennsylvania.

building materials along Clarion River near Foxburg.

geology of Clearfield County.

geological survey covering coal and other minerals of Butler County.

coal fields of Somerset County.

geological survey of Masontown quadrangle.

sources of dolomite.

interview on National Department Public Works.

paper "A Fuel Inspection System."

operations in the Sewickley Field—protesting character of advertising.

drilling in Indiana and Armstrong counties.

drilling in the McKeesport Field.

request for names of miners and producers of china clay.

request for gas and oil, Finleyville, Washington County.

request for information in re Classification of Coal.

request for information regarding mining conditions in Luzerne, Lackawanna, Schuylkill and Northumberland counties.

application for a position with the Survey.

acknowledgment of copies of preceding Commission report.

prepared 16 undictated letters.

By Mrs. Carey as follows: inquiries in regard to area in Nicholson Twp., Butler County (gas). area in Richland Twp., Butler County (oil and gas).

area in Parker Twp., Allegheny County.

mineral resources of the State by counties.

engagement to speak before the Oil Producers Association of Bradford, Pa.

gas sands near Sutersville, Pa.

geological surveys of Potter, McKean, Cameron and Clinton counties.

area around Beaver County.

area between Wilkes-Barre and Scranton.

deeper sands of Allegheny County and westward toward Ohio.

mining of siderite in this State.

anticline near Nine Mile Run.

oil and gas sands of Greene County.

geology of Tioga County.

cuts for article in Coal Age—Coal Classification.

serpentine of the southeastern part of State.

regarding "ice cave" near Coudersport, Potter County.

regarding "fox fire" occurrence in Huntingdon County.

geology of Highland Twp., Elk County.

Bradford County oil possibilities.

geology of Huntingdon County.

drilling in Bullskin Twp., Fayette County.

glass sands of the State

anticlines of southern Fayette County near Cheat Haven.

asked to recommend a geologist for private work in Mexico.

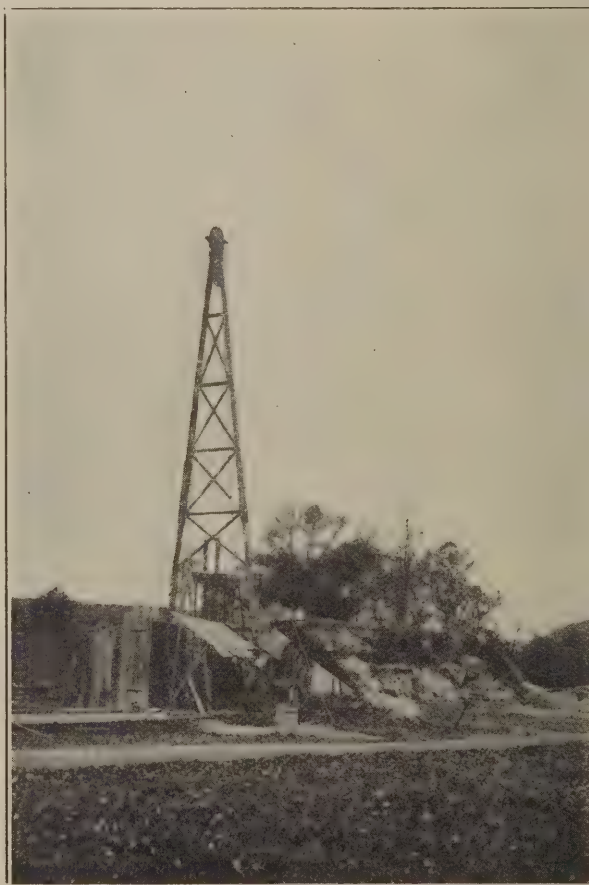
asked to present a discussion on Fire Clays at meeting of the American Ceramic Society.

prepared 14 undictated letters.

One phase of the information work will be enlarged on as it is believed that in that phase alone this Survey may save as much as it costs.

The constructional work of the Survey, such as the determination of the location, character and value of the mineral deposits, is necessarily slow and cumulative. But many opportunities have arisen during the year to put people on their guard in the matter of expenditures of time and money on what was likely to prove unprofitable. A few of these may be mentioned.

During the year there have been a number of



projects, in operation or proposed, (as illustrated by this drilling near Lancaster) to drill for oil or

gas in the metamorphosed rocks of the southeastern part of the State. A press bulletin called attention to the fact that past experience in such drilling had been quite fruitless and that the known conditions were such that no experienced geologist would recommend such drilling.

In another part of the State, a vast find of potash was announced. A member of the Survey visited the area and found a deposit of guano from woodchucks that had made their homes in the cavities of the rocks for an indefinite time, and of secondary incrustations in the crevices of the rocks, due to the solution of the guano and the redeposition of potassium nitrate.

A third line of warning has been to caution people in several sections of the State against large expenditures in seeking to develop coals of Pocono age. The coals occur in rocks far below the regular coal measures but locally they may present coal bed faces 3 to 6 feet thick. Experience in the mining of these coals, after the expenditure of hundreds of thousands of dollars, has uniformly been disappointing.

A fourth line has been in the endeavor to guide prospecting and drilling for oil and gas in the western part of the State. Only one example need be cited, as that received considerable attention in the public press. A rich strike of gas was made at McKeesport, in Allegheny County, in August, 1919. This was examined by the State Geologist in November, after which he issued a warning in connection with a description of the pool that "If one half of the gas wells now projected in McKeesport gas district are drilled, the immediate field will do well to last two years."

Conditions in the field were followed closely in succeeding months, all of the data as obtained being plotted on engineering paper so that the progress of the field could be watched as one watches an hour glass. As new large wells came in the interest increased, every day saw a dozen or a score of new companies organized, stock was being sold all over the country and hundreds of wells were projected or started, the number finally reaching over 1,000. December 29th the State Geologist again warned against sinking more wells in the pool ending his press bulletin with the statement "Therefore, I feel that it cannot be too strongly emphasized that while the Murrys ville field as a whole and outside the McKeesport pool is a legitimate field for development, further drilling in the McKeesport pool must result in serious financial losses." January 12th a more detailed analysis of the situation was submitted in the form of a mimeographed report in which it was stated: "It is estimated that the Long Run pool did not contain at the beginning over 15 to 20 billion cubic feet." and again: "The total volume of gas in the Long Run pool at the start may be closely estimated at 15 billion cubic feet which, at 15 cents a thousand, was worth about \$2,250,000." Careful estimates from the data available indicated 15 billion cubic feet as the original content of the pool. One factor in the problem could not be estimated for. Under the high pressure at the beginning, gas flowed from the Speechley sand, the principal source of the gas, into the closer grained Elizabeth sand exposed in the wells several hundred feet higher. It is believed that much of the gas at present coming from the field is com-



Estimated value of gas $2\frac{3}{4}$ millions; estimated expenditure, 22-28 millions (McKeesport).

ing from the Elizabeth sand as a result of the storage made during the early development of the field. How much gas was thus stored could not then be estimated upon. As a matter of fact, the recorded flow of gas in the field to October 1st, was 15,725,700,000 cubic feet. This, with the losses which may be roughly estimated as not less than 1,000,000,000 cubic feet, and the gas yet to come from the wells which may be two billion cubic feet, would indicate an original total of probably between 18 and 19 billion cubic feet, or well within the larger estimate of 20 billion cubic feet, made last December. **It is probable that the total value of the gas at the wells will reach 2¾ million dollars. Estimates of the actual money expended in the field or invested in stock vary from 28 to 22 million dollars.**

Of the wells actually completed by October first, 223 were productive and 313 or more unproductive. While at the time, full credence was not given to the State Geologist's statements, it is believed that the facts have demonstrated the correctness of his position and that as a consequence the Survey is in a position to render a larger future service than would otherwise have been possible.

Survey.

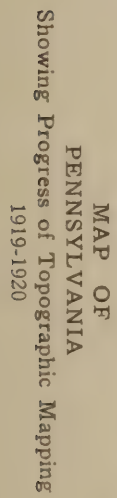
Topographic work. The field work of the Survey has naturally and properly taken up the larger part of the funds and energies of the Bureau. Topographic work is being carried on in cooperation with the U. S. Geological Survey, the work being under the direction of the latter's engineers, in accordance with past practice. Fifty-six per cent. of the State had been topographically mapped when the present Survey took hold. To obtain the largest possible amount of cooperation from the Federal Survey in order to push the topographical work to completion at the earliest possible moment, one half of the funds at the disposal of the Survey were allotted to this work. In addition, cooperation with the State Highway and Forestry Departments has been secured. The use of the Highway traverses and levels has greatly reduced the primary cost of topographic work. The topographic work is carried on and published in quadrangle areas, each covering 15 minutes of latitude and longitude and having an area of about 225 square miles. The following quadrangles have been completed during the year

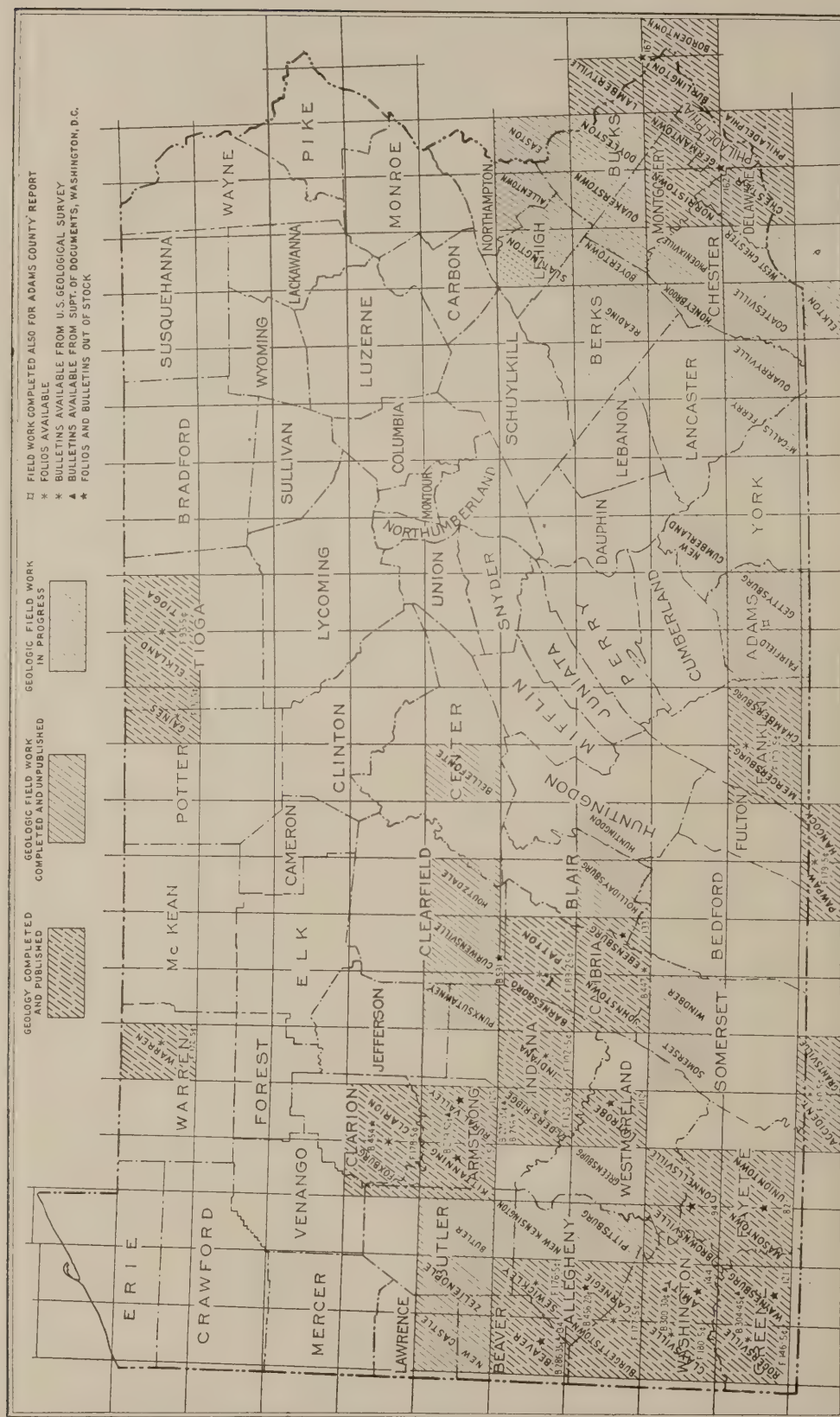
under the cooperative agreement: (See map) The Meyersdale sheet in southeastern Somerset County; the Confluence sheet, located in southeast Fayette and southwest Somerset counties; the Altoona sheet, located in Cambria and Blair counties. The conditions of the topographic field work as of September first were: the Stahlstown sheet, in Westmoreland and Fayette counties, 75% completed; the New Florence sheet, in Westmoreland and Indiana counties, 80% completed; the Hanover sheet, in York and Adams counties, 75% completed; the Philipsburg sheet, in Center and Clearfield counties, 30% completed; the Damascus sheet, in Wayne and Pike counties, 50% completed; the Long Eddy sheet in northeastern Wayne county is 50% completed. It is expected that the field work on all these sheets will be completed this season. The office preparation, engraving and printing of the maps will require another year or two.

Primary control has been completed on the Tyrone sheet, in Blair and Huntingdon counties; the Howard sheet, in Centre and Clinton counties; the Lock Haven sheet, in Clinton and Wyoming counties; the Williamsport sheet, in Clinton, Lycoming and Union counties; the Trout Run sheet, in Lycoming County; the Shippensburg sheet, in Cumberland, Franklin and Perry counties; the Mauch Chunk sheet, in Carbon and Northampton counties; and the Pocono sheet in Monroe county. The cost of this primary control was reduced not less than \$8,000 by the use of State Highway surveys, and the work correspondingly hastened.

Geologic work. The funds remaining for geological field work, after the allotment of one half for topographic work, and the necessary cost of administration and information, have been very small, and this has necessarily prevented undertaking a large amount of geological work greatly needed. The following brief summary shows the field and office work undertaken or completed:

Coal. Preparation of "An Introduction to the Bituminous Coal Fields of Pennsylvania" by the State Geologist, nearly completed. This discusses the several coals of the State, describes their the origin, kinds, character, analyses; and tests of the several coals of the State, describes their distribution by counties, estimates the reserves, and in general serves as a key to the more detailed volumes to follow.





MAP OF
PENNSYLVANIA

Showing progress of detailed geologic mapping. In the past this has been done by the U. S. Geological Survey, in part in cooperation with the State, in part without cooperation. Available folios or bulletins can be obtained from: The Director, U. S. Geological Survey, Washington, D. C.

Collection by Erle G. Hill of between 125 and 150 samples of coal scattered over sections of the State previously unsampled and their analysis by the U. S. Bureau of Mines under a cooperative agreement. Complete data on the mines visited was obtained at the same time. The work is still in progress. These analyses were needed to round out the discussion of the chemical character of Pennsylvania coal in the "Introduction" just mentioned.

A study and preliminary report on "River coal" as found in the Susquehanna, the Schuylkill and Lehigh Rivers and their tributaries, by C. W. Webbert. At the time this study was undertaken, the country was suffering a severe coal shortage, due to the countrywide coal strike. One result of this shortage was to bring many inquiries regarding "river coal," as the coal now being dredged out of the three rivers mentioned and their tributaries is called. Studies by Mr. Webbert, indicated that nearly 2,000,000 tons of coal were being yearly taken from these rivers and that there was prospect that the river coal will continue to serve Harrisburg and other cities for not less than ten years in the future.



Oil and Gas: The preparation to "An Introduction to the Oil and Gas Fields of Pennsylvania," by the State Geologist and J. French Robinson, to be accompanied by an up-to-date map of the oil and gas fields, from data supplied mainly by the U. S. Geological Survey. Similar in scope to the coal paper just mentioned. It

is hoped this paper may be issued before January 1st, 1921. (Still awaiting printing, Feb. 1922.)

Reconnaissance studies of the McKeesport gas field, and the preparation of a preliminary report thereon by the State Geologist. In addition to two press bulletins and a mimeograph report on this pool, graphic charts, blue printed, showing production, etc., also tables of figures, have been distributed or sent to the leading papers.

A detailed study of the McKeesport gas field by J. French Robinson and Roland W. Brown. Report will not be prepared until field is finished. The data available will permit a more detailed study of a gas field than has ever before been possible.

A rapid reconnaissance study of all of the oil and gas fields of the State by J. French Robinson, made in connection with the preparation of the "Introduction to the Oil and Gas Fields of Pennsylvania."

Preliminary mapping of the structure of the Pittsburgh and Greensburg quadrangles with special reference to oil and gas, by J. French Robinson and Roland W. Brown. (Mapping to 50 foot structure contours only.)

Detailed structure mapping and a study of the oil and gas resources of the New Kensington quadrangle, by George W. Richardson and assistants, in cooperation with the U. S. Geological Survey.

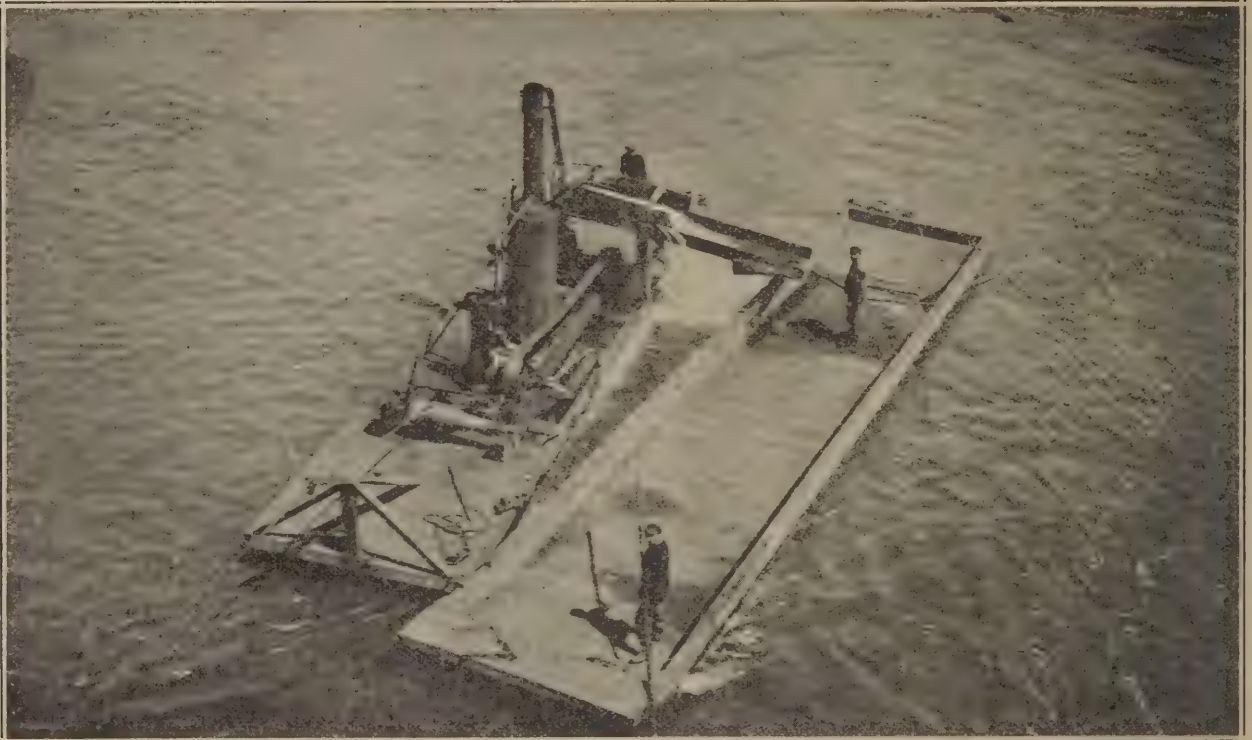
Study of the oil and gas resources of the New Castle quadrangle by Frederick B. Peck.

A study of reported oil seepages in Lancaster and Chester counties by the State Geologist.

Local detailed studies of oil and gas conditions at several points in the oil and gas fields, by the State Geologist and J. French Robinson.

Oil Shales: C. R. Fettke continued elaborate investigations of some 100 samples of black or bituminous shales gathered in 1918 and made a preliminary report on the results of his work. In the summer of 1920, Mr. Fettke made additional collections of samples in areas previously overlooked. These will form the subject of study the coming winter.

Limestone: The urgent need of the State Highway Department for information regarding suitable road building material in the northwestern part of the State, led in the fall of 1919 to an



The fine waste coal is pumped up with suction pumps and passed over screens which allow the water and sand to pass through while the coal is raked into a waiting barge.



Unloading "River Coal" before mechanical unloaders came into vogue.
Mining "River Coal" in Susquehanna River at Harrisburg.



Pennsylvania leads in limestone production

intensive study of the amount and character of the limestone resources in parts of the Beaver and Allegheny river districts with reference to possible quarry sites and the amount and character of stone in each, quarrying conditions, etc. Progress reports were made on this work every few days and transmitted at once to the Highway Department, followed by a series of detailed reports, with manuscript maps, photographs, etc. This work was under the immediate supervision of R. R. Hice, who with F. B. Peck, studied Beaver, Lawrence and Mercer counties. B. L. Miller and A. B. Fretz studied Armstrong and Clarion counties. C. R. Fettke and E. G. Hill studied northern Butler County.

In 1920 F. B. Peck completed the detailed study of the limestones of southern Lawrence County. B. L. Miller began the preparation of "An Introduction to the Limestones of Pennsylvania" which report will be similar in the method of treatment to the "Introduction to the Coal Fields" previously mentioned.

Ganister: A detailed study of the ganister of the State has been undertaken by E. S. Moore, assisted by Thomas G. Taylor.

Sandstone: J. French Robinson made a reconnaissance study of a high grade building sandstone found in Greene County.

Potash; etc.: A visit was made by B. L. Miller to the reported potash deposits of Potter County and a number of minor trips have been made by the State Geologist, B. L. Miller and other members of the Survey to examine reported deposits of value or to study the geology of local areas.

Granite, etc.: The desire of the Commissioners for the Memorial Bridge at Harrisburg, that that

bridge be built of Pennsylvania stone, led to a review of available stone for that purpose and the collection of blocks of granite and other building material.

M. H. Bissell made an extensive study of the building stone of the "Red Beds" areas of the New Cumberland quadrangle.

State Map: During the summer of 1920, George N. C. Henchen has been engaged in the preparation of data for a new geological map of the State.

Detailed Areal Studies: For many years the Federal Geological Survey has carried on detailed geological surveys of parts of Pennsylvania, partly in cooperation with the State and partly on its own resources. Such surveys are slow and expensive but furnish the bulk of the accurate, reliable information to be gotten by this Survey. In future field work of this character, the present Survey plans to secure the cooperation of the U. S. Geological Survey, maintaining, however, its own standards of work, and its own methods of publication. During the past year it has cooperated in the completion of several quadrangles, surveyed in the main in earlier years. This included studies in the Hanover, McCalls Ferry, Quarrysville, and other southeastern quadrangles by A. I. Jonas, representing the State Survey, in cooperation with E. F. Bliss and G. W. Stose of the Federal Survey. This work has been under the general supervision of Dr. F. Bascom.

E. T. Wherry completed a detailed geologic study of the Reading quadrangle.

A detailed areal and economic study of the "Red Beds" of the New Cumberland district by M. H. Bissell is in progress.

A study of the river and bench gravels and the recent geological history of the Susquehanna is in progress by H. L. Fairchild.

Publications.

The new Survey has as yet issued no reports or printed matter due to conditions beyond its control. The reports now being prepared must await the clearing up of the public printing situation. A monthly, illustrated bulletin, planned to secure quick publication of results, had to be abandoned after manuscript had been prepared.

The printing of a Glass Sand report prepared years ago by C. R. Fettke under the direction of

Mr. Hice and transmitted for printing in 1917 was finished and the report distributed during the year.

It is anticipated that this paper and the "Introduction to the Oil and Gas Fields of Pennsylvania" will be the only papers printed before the next session of the Legislature.

The list of proposed publications of the Survey, though all of uniform size and character, comprises four series of reports. These include:

A. A Topographic and Geologic Atlas of Pennsylvania in 204 parts, each to show on the scale of 1 inch equals 1 mile the topography and detailed geology of one quadrangle.

C. County reports, each covering one or more counties in non-technical language and fully illustrated by pictures and maps.

G. Geologic reports.

M. Mineral resource reports. Aside from general reports these will cover the State in a series of volumes including one or more for each important mineral resource.

For example; the bituminous coal fields are planned to be covered in nine handy volumes as follows: 1. Introduction, a comprehensive review of the fields as a whole, serving as a key to the other volumes (MS. nearly ready); 2. The Pittsburgh field; 3. The Beaver field; 4. The Lower Allegheny field; 5. The Eastern field; 6. The Upper Allegheny field; 7. The Northeastern field; 8. Coal mining methods and costs; 9. Coal conservation and utilization.

Of these proposed reports the map for the "Introduction to the oil and gas fields of Pennsylvania" is being engraved, and it is hoped to issue the report this fall. The "Introduction to the coal fields of Pennsylvania" is nearly prepared. The "Geology and Mineral Resources of Adams County" is well advanced as the first of the series of county reports. The "Introduction to the Limestones of Pennsylvania" is well advanced. A preliminary report on the oil shale studies is in hand.

In addition to surveys made during the past year, some 6,300 square miles of the State have been covered by detailed geologic surveys yet unpublished. Part of this work was done by the State in cooperation with the Federal Survey and part by the Federal Survey on its own initiative, and expense. As part of the general plan of cooperation with the Federal Survey, it is antici-

pated that a plan will be worked out by which all of this data will be available in some form for publication by the State. Some 675 square miles of this area, which was surveyed by the State Geologist in person, is now being made ready in preliminary form for publication as the first three units of the Topographic and Geologic Atlas of Pennsylvania.

The State Geologist has published a number of articles in technical journals during the year, including two in Coal Age; one in the Electrical World; one in the proceedings of the American Ceramic Society; one in the proceedings of the American Institute of Mining and Metallurgical Engineers. One paper by him previously prepared was published this year by the U. S. Geological Survey.

Plans and Methods.

Looking to the future the Survey aims to render **Service** in the sense of seeking to learn the needs and desires of the citizens of the State and then to meet those needs. This means more detailed surveys than have been made in the past. For it has been the general experience that when definite information was desired, such as that regarding road material in the fall of 1919, the old reports were found to be too general in character and new special surveys were necessary. It is believed that a little more time and expense on the original surveys will save the larger expense of later special surveys.

To determine the needs of people a careful analysis is being made of the questions asked the survey either by correspondence or in person. In addition attention is being given to those larger problems rising above the horizon, such as the location of "super power" stations, the recovery of residual oil in old pools, the possibility of extending the use of natural gas through the development of possible very deep reserves, the better utilization of our reducing coal supplies by preliminary low temperature distillation of the raw coal, electrification of railroads, etc., and in general, the future relations of the mineral resources of the State to the State's continued progress and growth in the large as well as in detail. In these matters the Survey will seek to lead through its accumulation of information.

To make its service of the largest value the Survey plans to make its reports as attractive and understandable as possible through the use of non-technical language and the liberal use of maps, charts and pictures, and to publish reports as soon after the field studies are made as careful office preparation and printing conditions will allow. The non-technical language will not apply to strictly technical papers intended as contributions to the professional geologist or engineer.

In addition to its published reports the Survey looks forward to becoming a storehouse of valuable detailed information through the gathering of records of all kinds relating to the mineral resources of the State, where any citizen of the State or others interested in the State may find any known facts regarding the State's geology and mineral resources.

Lest some may think that the economic end of the work is to be developed to the exclusion of the scientific and educational sides it may be said that the proposed list of studies and publications include a comprehensive series, from detailed studies in the mechanics of mountain building, for which no country offers more attractive ma-

terial than Pennsylvania, to **travelers guide's to the geology and resources along the great highways of the State** or articles and text books for the pupils in the schools. Indeed, given the support by the Legislature that is anticipated, the Pennsylvania Survey should become a "classic" second to none in the quality of its service.

In conclusion, the State Geologist wishes first to testify to the splendid service rendered by all members of the Survey. Notwithstanding the longer hours obtaining in this Bureau, the work has always exceeded our ability to do all that was needed, and has demanded and received not only undivided attention during office hours, but a large amount of overtime work given by members of the Survey on their own initiative. Indeed, probably a majority of nights have found one or more members of the Survey at their desks.

In the second place, he wishes to express his very great appreciation of the hearty cooperation given this Bureau and himself by Secretary Woodward and all other members of the Department, and to pledge to the Secretary his cooperation in helping carry out the Secretary's program to make the Department of Internal Affairs truly a "Department of Service."



The Pennsylvania Survey hopes to make known to the world both Pennsylvania's scenery and highways and to acquaint those using the highways with facts of popular, scientific, and economic interest along their way.



When properly interpreted every feature of a Pennsylvania landscape has its meaning. Here the flat top of the mountains tells of the long ages when Pennsylvania stood but little above sea level and was eroded down to an almost featureless plain. (The "Kittatinny peneplain.") The river gorge tells of a momentous uplift, and of the river cutting its channel down through the unlifted plain. The broad flat in the middle tells of another long quiet period during which much of Pennsylvania was again reduced to a plain but upon a lower level. (The "Harrisburg peneplain.") The hidden present channel tells of a still later uplift followed by the renewed cutting of the river. These are major features. Each minor feature reveals some episode of the State's history. One phase of the Survey's work will be, in the language of the law, "Elucidating the geology and topography of the State."



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